

REMARKS

The office action of March 27, 2006 has been reviewed and its contents carefully noted. Reconsideration of this case, as amended, is requested. Claims 1, 2, and 6 through 7 remain in this case, claims 3 through 5 being cancelled and claims 6 and 7 being added by this response.

Claim 1 was amended to clarify the subject matter being claimed. Support for the amendments to claim 1 are found in originally filed claim 3, Figures 3, 4a-4c, 6a-6c, and page 5-6, lines 4-11, page 6-7, lines 22-6 of the specification.

Claim 2 was amended to clarify the subject matter being claimed in relation to claim 1.

Support for new claims 6 and 7 are found in originally filed claims 4 and 5, Figure 9, and on pages 7-8, lines 24-2 of the specification.

The specification was amended to fix typographical errors, no new matter has been entered.

The Applicants note the Notice from the Official Draftsman referring to certain informalities in the Drawings. Replacement drawings correcting the informalities are enclosed with this response.

In addition, in Figure 9, reference number 508 was added to the figure. Support for the addition of reference number 508 to the figure is found on page 7, line 25. Reference number 500 was deleted and reference number 302 was added in its place. Support for the addition of reference number 302 is found on page 5, lines 10-13. No new matter has been entered.

A 1.132 affidavit is also enclosed with this response.

The numbered paragraphs below correspond to the numbered paragraphs in the Office Action.

Rejection(s) under 35 U.S.C. §102

2. Claims 1-4 were rejected under 35 U.S.C. 102(b) as being anticipated by Butterfield (US 5,657,725). Applicant respectfully disagrees with the rejection.

Reference numbers used below refer to elements in Butterfield (US 5,657,725) only.

Butterfield discloses a variable cam timing phaser in which at least supply oil and possible cam torque (if present in the advancing direction) is used to advance the phaser and cam torque only is used to retard the phaser. The first advance chamber (131b) is in fluid communication with the second retard chamber (132b). The first retard chamber (131a) is vented to atmosphere and the second advance chamber (132a) is connected to the main oil gallery (130).

When fluid flows from the first advance chamber (131b) to the second retard chamber (132b), fluid exits the first advance chamber (131b) through a line (625) connecting the spool valve (192) to the first advance chamber (131b). From the spool valve (192), fluid flows through a central line (182) through a first check valve (182a) to the second retard chamber (132b). When fluid flows from the second retard chamber (132b) to the first advance chamber (131b), fluid exits the second retard chamber (132b) through a line (624) connecting the spool valve (192) to the second retard chamber (132b). From the spool valve (192) fluid flows through a central line (182) through a second check valve (182b) to the first advance chamber (131b). Applicant points out that the recirculation of fluid between the first advance chamber (131b) and the second retard chamber (132b) cannot take place without both the first and second check valves (182a, 182b). Furthermore, the check valves and all recirculation of fluid is carried out between the spool valve and the chambers.

In Applicant's invention, a single recirculation check valve in a return passage between the supply and the spool valve allows recirculation between the advance chamber and the retard chamber and vice versa. As stated in Applicant's amended claim 1, in part,

"...a spool valve comprising a spool having a plurality of lands slidably mounted within a bore in the rotor, the spool slidable from an advance position through a holding position to a retard position;

"an advance passage extending from the advance chamber to the spool valve;

"a retard passage extending from the retard chamber to the spool valve;

"an advance exhaust passage extending from the spool valve to a return passage, for routing fluid back to the advance chamber and the retard chamber through the spool valve;

"a retard exhaust passage extending from the spool valve to the return passage for routing fluid back to the advance chamber and the retard chamber through the spool valve;

"a single recirculation check valve in the return passage allowing fluid to flow in a first direction and preventing fluid flow in an opposite direction;

"a supply passage coupled to the return passage for supplying operating fluid to the advance chamber and the retard chamber through the single recirculation check valve for makeup only;

"wherein the single recirculation check valve in the return passage is between the supply passage and the spool valve;

"wherein when the spool is in the retard position, fluid flows from the advance chamber through the advance passage, the spool and the advance exhaust passage and into the return passage through the single recirculation check valve to the retard chamber; and

"wherein when the spool is in the advance position fluid flows from the retard chamber through the retard passage, the spool and the retard exhaust passage and into the return passage through the single recirculation check valve to the advance chamber."

Butterfield does not have an advance exhaust passage, a retard exhaust passage, a return passage between the supply passage and the spool valve or a single recirculation check valve in the return passage. Recirculation of fluid between the advance chamber and the retard chamber takes place between the spool valve and the return passage between the spool valve and the supply passage. From the return passage, fluid flows from the spool valve back to the chambers.

Fluid recirculation does not take place between the chambers and the spool valve only, as in Butterfield.

In addition, fluid from supply is used for makeup only in the present invention, not to advance the phaser as in Butterfield or act as a biasing force. Butterfield specifically states in column 10, lines 15-17, "One method of applying such a force is to modify the hydraulic line configuration so that engine oil can be utilized as a biasing force". Furthermore, Applicant's phaser has a holding position, Butterfield specifically states in column 10, lines 17-20 "This embodiment is a two position device only, that is full advance or full retard, can not maintain an intermediate position."

Applicant's new claim 6 states:

"A variable cam timing phaser for an internal combustion engine having at least one camshaft comprising:

"a housing having an outer circumference for accepting drive force;

"a rotor for connection to a camshaft coaxially located within the housing, the housing and the rotor defining at least one vane separating a plurality of chambers, at least one chamber being an advance chamber and another chamber being a retard chamber, the vane being capable of rotation to shift the relative angular position of the housing and the rotor;

"a spool valve comprising a spool having a plurality of lands slidably mounted within a bore in the rotor, the spool slidable from an advance position through a holding position to a retard position;

"an advance passage extending from the advance chamber to the spool valve;

"a retard passage extending from the retard chamber to the spool valve;

"an advance exhaust passage extending from the spool valve to a return passage, for routing fluid back to the advance chamber and the retard chamber through the spool valve;

"a retard exhaust passage extending from the spool valve to the return passage for routing fluid back to the advance chamber and the retard chamber through the spool valve;

"a connecting passage extending from the advance passage to the retard passage coupled to supply, the connecting passage having a first inlet check valve between the supply and the advance passage and a second inlet check valve between the supply and the retard passage;

"a single recirculation check valve in the return passage allowing fluid to flow in a first direction and preventing fluid flow in an opposite direction;

"wherein the single recirculation check valve in the return passage is between the supply passage and the spool valve;

"wherein when the spool is in the retard position, fluid flows from the advance chamber through the advance exhaust passage and into the return passage through the single recirculation check valve to the retard chamber;

"wherein when the spool is in the advance position fluid flows from the retard chamber through the retard exhaust passage and into the return passage through the single recirculation check valve to the advance chamber; and

"wherein when the spool is in the holding position, fluid flows from the supply, through the connecting passage and the first inlet check valve to the advance chamber and through the second inlet check valve to the retard chamber for makeup only."

As Butterfield applies to Applicant's new claim 6, Butterfield does not have an advance exhaust passage, a retard exhaust passage, a return passage between the supply passage and the spool valve or a single recirculation check valve. Butterfield also does not have a passage extending from the advance passage to the retard passage coupled to supply, with the passage having a first inlet check valve between the supply and the advance passage and a second inlet check valve between the supply and the retard passage.

In addition, fluid from supply is used for makeup only in the present invention, not to advance the phaser as in Butterfield or act as a biasing force. Butterfield specifically states in column 10, lines 15-17, "One method of applying such a force is to modify the hydraulic line configuration so that engine oil can be utilized as a biasing force". Furthermore, Applicant's phaser has a holding position, Butterfield specifically states in column 10, lines 17-20 "This embodiment is a two position device only, that is full advance or full retard, can not maintain an intermediate position."

Therefore, it is respectfully suggested that the rejection of independent claim 1 and 6 as being anticipated by Butterfield (US 5,657,725) is overcome. Dependent claims 2 and 7, being dependent upon and further limiting independent claims 1 and 6 respectively, should also be allowable for that reason, as well as for the additional recitations they contain. Reconsideration and withdrawal of the rejection are respectfully requested.

4. Claims 1-5 were rejected under 35 U.S.C. 102(e) as being anticipated by Smith et al. (US 6,453,859).

Applicant has cancelled claims 3 through 5 in order to further prosecution. As far as the rejection applying to newly amended claim 1, and new claims 6 and 7, the Applicant has submitted an affidavit under 37 CFR 1.132 with this response in which Marty Gardner unequivocally states that he is the sole inventor of the use of a single check valve for recirculation of fluid for use during cam torque actuation in a variable cam timing phaser disclosed in US 6,453, 859, but not claimed. The subject matter above is attributed to Marty Gardner, an inventor in both the present application and US 6,453,859, and thus the application is not by "another".

Therefore, it is respectfully suggested that the rejection of independent claim 1 as being anticipated by Smith et al. (US 6,453,859) is overcome. Dependent claim 2, being dependent upon and further limiting independent claim 1, should also be allowable for that reason, as well as for the additional recitations they contain. Reconsideration and withdrawal of the rejection are respectfully requested.

Conclusion

Applicant believes the claims, as amended, are patentable over the prior art, and that this case is now in condition for allowance of all claims therein. Such action is thus respectfully requested. If the Examiner disagrees, or believes for any other reason that direct contact with Applicants' attorney would advance the prosecution of the case to finality, he is invited to telephone the undersigned at the number given below.

"Recognizing that Internet communications are not secured, I hereby authorize the PTO to communicate with me concerning any subject matter of this application by electronic mail. I understand that a copy of these communications will be made of record in the application file."

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